

What is claimed is:

1. A retaining ring for use on a carrier head in a chemical mechanical polishing apparatus, comprising:
  - 5 an annular ring having a bottom surface, an inner surface and an outer surface; and a plurality of recesses on the bottom surface, each recess includes an inner trailing surface, a slurry capture area, and a channel connecting the slurry capture area to the inner surface.
- 10 2. The retaining ring of claim 1, wherein the inner trailing surface inclines backward and forms an acute angle with respect to the bottom surface.
- 15 3. The retaining ring of claim 1, wherein the inner trailing surface inclines forward and forms an obtuse angle with respect to the bottom surface.
- 20 4. The retaining ring of claim 1, wherein the inner trailing surface is configured for fastening thereon an insert tool having a contact edge for contacting abrasively a polishing pad on the chemical mechanical polishing apparatus.
- 25 5. The retaining ring of claim 1, wherein the annular ring is constructed from a material selected from a group consisting of polyphenyl sulfide (PPS), polyimide, polybenzimidazole (PBI), polytetrafluoroethylene (PTFE), polyetheretherketone (PEEK), polycarbonate, acetal, polyetherimide (PEI), or combinations thereof.
- 30 6. The retaining ring of claim 1, wherein at least one the recesses has a shape designed for nesting and is positioned on the bottom surface nested with at least another recess.
7. The retaining ring of claim 1, wherein the total recessed area covered by the plurality of recesses constitutes between 20% to 80% of the total projected surface area of the bottom surface.

8. The retaining ring of claim 1, wherein the channel is positioned in a plane that is essentially parallel and at a distance from the bottom surface.

5 9. The retaining ring of claim 1, wherein each recess has a three-dimensional shape designed to maintain the functional performance of the retaining ring as a thickness of the retaining ring shrinks.

10 10. The retaining ring of claim 1, wherein each recess includes a slurry feeding area.

15 11. The retaining ring of claim 1, wherein the slurry feeding area includes an opening on the outer surface of the annular ring and the total surface areas of all the openings on the outer surface constitute between 20% to 80% of the total projected surface areas of the outer surface.

12. The retaining ring of claim 1, wherein the inner surface includes a cut connecting to the channel.

20 13. The retaining ring of claim 1, wherein each recess includes an outer trailing surface.

14. The retaining ring of claim 1, wherein the outer trailing surface inclines backward and forms an acute angle with respect to the bottom surface.

25 15. The retaining ring of claim 1, wherein the outer trailing surface inclines forward and forms an obtuse angle with respect to the bottom surface.

30 16. The retaining ring of claim 1, further comprising an insert tool fastened on the inner trailing surface.

17. The retaining ring of claim 16, wherein the insert tool is made from a metal carbide.

18. The retaining ring of claim 17, wherein a surface of the insert tool is treated to  
5 enhance wear resistance.

19. The retaining ring of claim 16, wherein the insert tool has a contact edge including a single contact point.

10 20. The retaining ring of claim 16, wherein the insert tool has a contact edge including multiple contact points.

21. The retaining ring of claim 16, wherein the insert tool has an end in the form of a scraper blade.

15 22. The retaining ring of claim 16, wherein the insert tool has an end in the form of a rounded peak.

23. The retaining ring of claim 16, wherein the insert tool has a head that includes  
20 a rounded surface and a tilted surface.

24. The retaining ring of claim 16, wherein the insert tool has a shoulder for setting a height of a contact edge with respect to the bottom surface.

25 25. A retaining ring for use on a carrier head in a chemical mechanical polishing apparatus, comprising:

an annular ring having a bottom surface, an inner surface and an outer surface; and  
a plurality of recesses on the bottom surface, each recess includes an inner trailing surface configured for fastening thereon an insert tool having a contact edge for contacting  
30 abrasively a polishing pad on the chemical mechanical polishing apparatus.

26. The retaining ring of claim 25, further comprising an insert tool fastened on the inner trailing surface.

27. The retaining ring of claim 26, wherein the insert tool is made from metal, and  
5 at least a portion of the surface of the insert tool are coated with diamond.

28. The retaining ring of claim 27, wherein the insert tool has a sharp edge coated with a diamond layer.

10 29. The retaining ring of claim 27, wherein the insert tool has a rounded surface coated with a diamond grit.

30. The retaining ring of claim 26, wherein the insert tool having a contact edge including a single contact point.

15 31. The retaining ring of claim 26, wherein the insert tool having a contact edge including multiple contact points.

20 32. The retaining ring of claim 26, wherein the insert tool having an end in the form of a scraper blade.

33. The retaining ring of claim 26, wherein the insert tool having an end in the form of a rounded peak.

25 34. The retaining ring of claim 26, wherein the insert tool having a head that includes a rounded surface and a tilted surface.

35. The retaining ring of claim 26, wherein the insert tool having a shoulder for setting a height of a contact edge with respect to the bottom surface.

36. A retaining ring for use on a carrier head in a chemical mechanical polishing apparatus, comprising:

an annular ring having a bottom surface, an inner surface and an outer surface;  
a plurality of recesses on the bottom surface, each recess includes an inner trailing  
5 surface, an outer trailing surface, and a slurry capture area between the inner trailing surface  
and the outer trailing surface; and  
a plurality of openings on the inner surface connecting with the slurry capture area.

37. The retaining ring of claim 36, wherein the inner trailing surface inclines  
10 backward and forms an acute angle with respect to the bottom surface.

38. The retaining ring of claim 36, wherein the inner trailing surface inclines  
forward and forms an obtuse angle with respect to the bottom surface.

15 39. The retaining ring of claim 36, wherein the outer trailing surface inclines  
backward and forms an acute angle with respect to the bottom surface.

40. The retaining ring of claim 36, wherein the outer trailing surface inclines  
forward and forms an obtuse angle with respect to the bottom surface.